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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/512,378
Filing Date: February 25, 2000
Appellant(s): AU ET AL.

James A. LaBarre
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 26 March 2007 appealing from the Office action mailed 25 September 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

Grounds of Rejection Withdrawn

a. Rejections under 35 USC §101.

b. Rejection of claim 22 under 35 USC §112, first paragraph.

c. Rejections under 35 USC §112, second paragraph.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,101,285	FAN	8-2000
5,506,699	WONG	4-1996

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 2-4, 16 and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Fan (US Patent 6,101,285).

Regarding claims 2 and 19: Fan discloses:

- defining a set of neighborhood pixels of the individual pixel (figure 8a(($m - T_x, n$),(m, n), ($m + T_x, n$)) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m, n) of Fan) and additionally a plurality of pixels generated proximate said individual pixel (figure 8a(($m - T_x, n$),($m + T_x, n$)) of Fan).
- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving the reconstructed value of the individual pixel ($y(m, n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the halftone image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Further regarding claim 19: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 3: Fan discloses that said halftone image is derived from an original image having a continuous value for each pixel (column 6, lines 38-41 of Fan), and, for each individual pixel, said significance coefficient of each neighborhood pixel is an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan). As discussed above in the arguments regarding claim 2, the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan), which sets the significance coefficient column 7, lines 54-58 of Fan). The difference between the neighborhood pixel and the individual pixel in an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image since, the higher the level of difference, the less likely it is that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image.

Regarding claim 4: Fan discloses deriving a baseline value (x*(m,n)) for the individual pixel (column 6, lines 47-50 of Fan), and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel and of the baseline value for the individual pixel (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan).

Regarding claim 16: <u>Fan discloses:</u>

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x, n)$,(m, n), $(m+T_x, n)$) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the

individual pixel (figure 8a(m, n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a(($m - T_x, n$),($m + T_x, n$)) of Fan).

- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving the reconstructed value of the individual pixel ($y(m, n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the first value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Claims 1, 5, 11-15, 17-18 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fan (US Patent 6,101,285) in view of Wong (US Patent 5,506,699).

Regarding claims 1 and 18: Fan discloses:

- for each pixel, defining a respective neighborhood (figure 8a(($m - T_x, n$),(m, n),($m + T_x, n$)) and column 6, lines 42-47 of Fan) containing that pixel (figure 8a(m, n) of Fan) and other pixels (figure 8a(($m - T_x, n$),($m + T_x, n$)) of Fan).

- in a first iteration, obtaining for each individual pixel a continuous value ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) by summing the products of weighting values (α and ($1-\alpha$)) and the continuous values of the pixels in the neighborhood of the individual pixel (column 7, lines 48-58 of Fan), the weighting values being derived from the continuous values of the halftoned image (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The weighting values for the neighborhood pixels (α and ($1-\alpha$)) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

Fan does not disclose expressly that said values of the pixels are binary values; and, in further iterations, obtaining for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to begin with binary image data, as taught by Wong, which would modify the teaching of Fan such that only one location is within the pixel window

for pixel processing. The suggestion for doing so would have been that binary image data is the simplest image data to start with and would also simplify the individual pixel value determination step taught by Fan. Furthermore, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, in further iterations, Fan in view of Wong obtains for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 1 and 18.

Further regarding claim 18: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 5: Fan does not disclose expressly that the baseline value for the individual pixel is derived by low pass filtering of the halftone image.

Wong discloses deriving a baseline value for the individual pixels by low pass filtering the halftone image (figure 2(18) and column 5, lines 6-9 and lines 13-17 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a low pass filter to obtain the baseline value, as taught by Wong. The motivation for doing so would have been to avoid overly blurring the

resultant image (column 5, lines 16-19 of Wong). Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 5.

Regarding claim 11: Fan does not disclose expressly forming an enhanced reconstructed image as a linear combination of said reconstructed image and a continuous image derived from said halftone image by a second image reconstruction method.

Wong discloses forming an enhanced reconstructed image as a linear combination of said reconstructed image (figure 3(24) of Wong) and a continuous image derived from said halftone image by a second image reconstruction method (figure 3(26) of Wong) (column 6, lines 35-37 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a final low pass filter in linear combination with the reconstructed image, as taught by Wong. The motivation for doing so would have been to remove unwanted high frequency components that may be generated at the final stage of continuous-tone image reconstruction (column 6, lines 35-37 of Wong). Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 11.

Further regarding claim 12: Wong discloses that said second image reconstruction method is a low pass filter (figure 3(26) and column 6, lines 35-37 of Wong).

Regarding claims 13 and 20: <u>Fan discloses:</u>

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x,n)$,(m,n), $(m+T_x,n)$) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m,n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a($(m-T_x,n)$,$(m+T_x,n)$) of Fan).
- deriving for each pixel of said first neighborhood, a respective significance coefficient (α) (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance

coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

- deriving a first reconstructed value of the individual pixel ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the neighborhood pixels of a product of the halftone image value at that neighborhood pixel with the respective significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Fan does not disclose expressly M further steps, m=1,...,M ($M \geq 1$), of: for successive individual ones of said pixel: rederiving a significance coefficient for each neighborhood pixel; and deriving an (m+1)-th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m-th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, Fan in view of Wong would perform M further steps, m=1,...,M ($M \geq 1$), of: for successive individual ones of said pixel: rederiving a significance coefficient for each neighborhood pixel; and deriving an (m+1)-th reconstructed value of the individual pixel as a sum over the neighborhood pixels of

the product of the m-th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 13 and 20.

Further regarding claim 20: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claims 14, 17 and 21: Fan discloses, for successive pixels (figure 4(320) and column 6, lines 38-41 of Fan):

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x,n)$,(m,n), $(m+T_x,n)$) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m,n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a($(m-T_x,n)$,$(m+T_x,n)$) of Fan).
- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

- deriving the reconstructed value of the individual pixel ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Fan does not disclose expressly preprocessing the halftone image by a filtering algorithm to derive a preprocessed image having a preprocessed image value for each of said pixel.

Wong discloses preprocessing the halftone image by a filtering algorithm (figure 2(18) of Wong) to derive a preprocessed image having a preprocessed image value for each of said pixels (column 5, lines 6-8 of Wong). The first stage by which the initial binary data is processed in a low-pass filter (figure 2 (18) and column 5, lines 7-8 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preprocess the halftone image, as taught by Wong, before performing the method taught by Fan. The motivation for doing so would have been to remove unwanted high frequency components (column 5, lines 13-16 of Wong) from the halftone binary image. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 14, 17 and 21.

Further regarding claim 17: The "first value" recited in claim 17 corresponds to the "halftone image value" recited in claim 14. Further, the "first image" recited in claim 17 corresponds to the "halftone image" recited in claim 14. Therefore, the limitations of claim 17 are fully embodied within the limitations recited in claim 14.

Further regarding claim 21: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 15: Fan discloses deriving a baseline value (x*(m,n)) for the individual pixel (column 6, lines 47-50 of Fan), and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel and of the baseline value for the individual pixel (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan). By combination with Wong, said halftone value for the image at that neighborhood pixel is a preprocessed value.

Regarding claim 22: Fan discloses an apparatus (figure 9 of Fan) comprising:

- an image receiver (figure 9(802) of Fan) for receiving a first image (column 5, lines 40-45 of Fan).
- an image processor (figure 9(804) and column 5, lines 24-25 of Fan) which performs the steps of:
  - for each pixel, defining a respective neighborhood (figure 8a($(m-T_x,n)$,(m,n), $(m+T_x,n)$) and column 6, lines 42-47 of Fan) containing that pixel (figure 8a(m,n) of Fan) and other pixels (figure 8a($(m-T_x,n)$,$(m+T_x,n)$) of Fan).
  - in a first iteration, obtaining for each individual pixel a continuous value ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) by summing the products of weighting values (α and (1-α)) and the continuous values of the pixels in the neighborhood of the individual pixel (column 7, lines 48-58 of Fan), the weighting values being derived from the continuous values of the halftoned image (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The weighting values for the neighborhood pixels (α and (1-α)) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference

used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

Fan does not disclose expressly that said values of the pixels are binary values; and, in further iterations, obtaining for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to begin with binary image data, as taught by Wong, which would modify the teaching of Fan such that only one location is within the pixel window for pixel processing. The suggestion for doing so would have been that binary image data is the simplest image data to start with and would also simplify the individual pixel value determination step taught by Fan. Furthermore, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, in further iterations, Fan in view of Wong obtains for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need

correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 22.

Claims 6-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fan (US Patent 6,101,285) in view of Wong (US Patent 5,506,699) and obvious engineering design choice.

Regarding claim 6: Fan discloses that, for each individual pixel, the significance coefficient for each neighborhood pixel is an increasing function f(v) of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel (column 7, lines 48-58 of Fan). For an increasing absolute difference between a pixel and a neighboring pixel, the value of the significance coefficient (α) increases (column 7, lines 48-58 of Fan).

Fan in view of Wong does not disclose expressly that f(v) is a decreasing function. However, it would have been an obvious engineering design choice to set the function f(v) to be a decreasing function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel. All that this would require is that the equation for y(m,n) (column 7, lines 51-53 of Fan) be reformatted to read: $y(m,n)=(1-\alpha)x*(m-T_x,n)+\alpha x*(m,n)$ when $|dif0|\leq|dif1|$ and $y(m,n)=(1-\alpha)x*(m+T_x,n)+\alpha x*(m,n)$ otherwise. In this formulation, the value of α would be a decreasing function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel, but nothing in the actual substance of the system would change. The only change would be in exactly how the equations were formulated, specifically where α is used and where ($1-\alpha$) is used.

Regarding claims 7 and 8: Fan discloses that f(v) increases as a function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel (column 7, lines 48-58 of Fan). While f(α) can be seen to be smooth since α increases or decreases based on the amount of edge enhancement needed (column 7, lines 54-58 of Fan), the value upon which

the significance coefficient depends, namely σ, is a parameter that can be set by the user (column 6, lines 55-65 of Fan). Furthermore, the nature of how $f(\alpha)$ is established reasonably suggests that $f(\alpha)$ is not necessarily linear (column 6, lines 50-67 of Fan). Thus, $f(\alpha)$ is both a non-linear function and a continuous (smooth) function.

Regarding claim 9: Fan in view of Wong and obvious engineering design choice teaches that f(v) is a function of the form $f(v) = a(1 - v/b)^k$ where a and b are predefined numbers and k is a predefined integer for the following reasons:

1. Fan teaches that f(v) is an increasing function of v, or: $f(v) \propto v^k$ where k is a predefined integer.
2. By normalization, which is a common practice and could be considered part of the obvious engineering design choice for the function, $f(v) \propto a\left(\frac{v}{b}\right)^k$ where a and b are predefined numbers and k is a predefined integer.
3. As per the arguments regarding claim 6, the combination of Fan in view of Wong and obvious engineering design choice sets forth that f(v) is a decreasing function such that $(1-\alpha)$ is used in the resulting output equations where α was previously used. Thus, a corresponding change in f(v) set forth above would result in $f(v) = a(1 - v/b)^k$ where a and b are predefined numbers and k is a predefined integer.

(10) Response to Argument

Rejections under 35 U.S.C. §101 [see page 7, line 2 to page 11, line 25 of Appeal Brief]:

The rejections under 35 USC §101 have been withdrawn.

The Rejection of claim 22 under 35 USC §112, first paragraph [see page 11, line 26 to page 13, line 26 of Appeal Brief]:

The rejection of claim 22 under 35 USC §112, first paragraph has been withdrawn.

The Rejections under 35 USC §112, second paragraph [see page 13, line 27 to page 15, line 4 of Appeal Brief]:

The rejections under 35 USC §112, second paragraph have been withdrawn.

The Rejections under 35 USC §102 [see page 15, line 5 to end of page 16 of Appeal Brief]:

First, the defined neighborhood as described in the office action mailed 25 September 2006 is the set of pixels $(m - T_x, n)$, (m, n), and $(m + T_x, n)$ shown in figure 8a of Fan [see last two lines of page 10 to page 11, line 4 of said office action].

Now, with respect to the recited significance coefficient, two underlying interpretations seem to have been made by Appellant, namely (1) that the significance coefficient for each neighborhood pixel is calculated based on the value of the neighborhood pixel *alone* and (2) that the resultant value of each significance coefficient is different from each other significance coefficient in the same neighborhood of pixels. However, the language of claim 2 does not specifically recite this. Claim 2 recites that a significance coefficient be derived for each neighborhood pixel and that the significance coefficent be based upon the value of the neighborhood pixel ("that pixel").

The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed [see column 7, lines 54-58 of Fan]. The amount of edge enhancement that is to be performed is directly determined from the values of each of the neighborhood pixels since the differences [given by dif0 or dif1] between each neighborhood pixel and the target pixel are calculated [see column 6, lines 52-58 of Fan] and the calculation of said difference is used to determine the amount of edge enhancement that is to be performed [column 7, lines 29-43 of Fan]. The variable dif0 is determined based on the difference between the pixels at (m,n) and $(m-T_x,n)$ and dif1 is determined based on the difference between the pixels at (m,n) and $(m+T_x,n)$ [see column 6, lines 52-58 of Fan]. The values of dif0 and dif1 are used to ultimately deteremine the value of the significance coefficient (α) [see column 7, lines 29-43 and lines 51-58 of Fan]. Thus, the significance coefficient for each of of the neighborhood pixels is based on the value of each of the neighborhood pixels since each pixel value is used to determine the edge amount, which in turn determines the significance coefficient.

Further, even *arguendo* if Appellant's interpretation requiring different values for the significance coefficients of each pixel of the neighborhood is taken as given, such an interpretation can still be considered as taught by Fan. As can be seen from the equations set forth in column 7, lines 50-58 of Fan:

$$y(m,n)=\alpha x*(m-T_x,n)+(1-\alpha)x*(m,n) \text{ when } |dif0|\le|dif1| \text{ and}$$

$$y(m,n)=\alpha x*(m+T_x,n)+(1-\alpha)x*(m,n) \text{ otherwise.}$$

Thus, depending on the comparison of the absolute values of dif0 and dif1, which are calculated based on the neighborhood pixel values, the significance coefficient for a neighborhood pixel can be α, (1-α), or zero. In order to determine the output pixel value at (m,n) [given by y(m,n)], $x*(m-T_x,n)$ is multipled

by either α or zero, and $x^*(m+T_x,n)$ is multipled by either α or zero – based on the result of the comparison of the absolute values of dif0 and dif1 – while $x^*(m,n)$ is multiplied by (1-α).

Finally, even if the pixels at $(m-T_x,n)$, (m,n), and $(m+T_x,n)$ are considered groups of pixels rather than individual pixels, the rejection based on Fan is still valid since the pixels at $(m-T_x,n)$ would all have a significance coefficient of either α or zero, the pixels at $(m+T_x,n)$ would also all have a significance coefficient of either α or zero, and the pixels at (m,n) would all have a significance coefficient of (1-α). The values would be based on the values of the neighborhood pixels since the neighborhood pixels would be required to first compute the average, and then compute dif0 and dif1. Again, Appellant's apparent interpretation that the significance coefficient for a neighborhood pixel is based *only* on the value of the individual neighborhood pixel ("that pixel") is not a requirement of, or inherent in, the specifically recited language of claim 2.

Since Appellant argues the same features for claim 16 as are argued for claim 2, Examiner's arguments with respect to claim 2 set forth above also apply to Appellant's arguments with respect to claim 16.

<u>The Rejections under 35 USC §103 [see page 17, line 1 to page 21, line 12 of Appeal Brief]:</u>

<u>With respect to page 17, line 3 to page 18, line 22 (Section E.1.a) of Appeal Brief:</u>

Firstly, Appellant's arguments with respect to the computation of α have already been addressed above. Examiner has demonstrated that α is derived from the values of the neighborhood pixels.

Appellant argues that Wong, if combined with Fan, would destroy the principle of operation of Fan. *Examiner replies* that Fan discloses a system and method which reconstructs continuous-tone values from an image that has been halftoned. Wong is relied upon for its teaching with respect to performing

iterative processing of a method which reconstructs continuous-tone values from a halftoned image, and for its teaching with respect to starting with binary data. While the pixel value in each windowed block would be averaged with itself in determining the values of $x^*(m-T_x,n)$, $x^*(m,n)$, and $x^*(m+T_x,n)$, this would not leave the *output* values of $y(m,n)$ (computed for each position m,n over the image space) unchanged after the total processing is completed. The value of α is based on the difference between values in the windowed regions, and applying the equations set forth on column 7, lines 50-53 of Fan would result in a new value for the output pixel at location (m,n). This process would occur for each pixel of the image as the location (m,n) is updated for each value of m and each value of n throughout the image space. Thus, the resultant image of the first iteration according to the combined teachings of Fan in view of Wong would be continuous values for each binary pixel that are computed from the aforementioned equation.

Furthermore, iterative processing of the image would not destroy the principle of operation of the system taught by Fan. The original calculation using the equations:

$$y(m,n)=\alpha x^*(m-T_x,n)+(1-\alpha)x^*(m,n) \text{ when } |dif0|\le|dif1| \text{ and}$$

$$y(m,n)=\alpha x^*(m+T_x,n)+(1-\alpha)x^*(m,n) \text{ otherwise}$$

would provide output values $y(m,n)$ for each m and each n over the entire image space. These output pixel values would then be used as the updated values for $x^*(m-T_x,n)$, $x^*(m,n)$, and $x^*(m+T_x,n)$ in the next iteration, thus allowing for the computation of newer updated output pixel values for each m and each n over the entire image space. Since the values of each pixel of the image would be updated at each iteration, the values of the significance coefficients and weighting coefficients would also be updated since the significance coefficients and weighting coefficients are based on the neighborhood

pixel values. As stated on page 16 of the previous office action, performing multiple passes of the image reconstruction would improve the overall result since, by running just one pass with the system of Fan, there are likely to still be edge artifacts that need smoothing, along with other artifacts that need correction. An image reconstruction algorithm such as taught by Fan does not generally produce a "perfect" result after a single iteration. Applying the teachings of Wong, and thus performing the method of Fan iteratively, will produce a superior resultant image by obtaining pixel values that have been processed to a better iterative convergence.

<u>With respect to page 18, line 23 to page 20, line 2 (Section E.1.b) of Appeal Brief:</u>

Firstly, Appellant's arguments with respect to the computation of the significance coefficient (α) have been fully addressed above in the section regarding the rejections under 35 USC §102. Furthermore, Appellant's arguments with respect to applying iterative processing, as taught by Wong, to the system and method taught by Fan have been fully addressed above in the section regarding Section E.1.a of the Appeal Brief.

Appellant argues that Wong would not suggest rederiving the significance coefficients, even if the iterative processing taught by Wong were applied to the system taught by Fan. *Examiner replies* that, as demonstrated above, the significance coefficient is derived from the neighborhood pixel values. Thus, if an iterative processing is applied to the system and method taught by Fan, the significance coefficient will be rederived due both to the fact that the image reconstruction is performed again, and the fact that the pixel values for each particular neighborhood will have been updated (and thus changed) since the last iteration. With new pixel values in a pixel neighborhood, a new significance coefficient will need to be rederived since the significance coefficient of the previous iteration is based on pixel values that have now been changed.

With respect to page 20, lines 3-15 (Section E.1.c) of Appeal Brief:

Appellant's arguments in Section E.1.c of the Appeal Brief, as admitted, are arguments already set forth in prior portions of the Appeal Brief. Thus, Appellant's arguments in Section E.1.c of the Appeal Brief have already been fully addressed by Examiner.

With respect to page 20, line 16 to page 21, line 9 (Section 2) of Appeal Brief:

In the previous office action, Examiner cited column 7, lines 48-58 of Fan to teach that the function for the significance coefficient is an increasing function of the absolute value of the difference of the halftone value of the neighborhood pixel and the baseline values of the individual pixel. The cited portion of Fan states that α has a value between 0 and 1, depending on the level of edge enhancement is to be applied. If there is a greater absolute value of the difference of the halftone value of the neighborhood pixel and the baseline values of the individual pixel, then there is both a greater probability of an edge between the neighborhood pixel and the individual pixel, and a greater amount of edge enhancement that would be needed since the difference in pixel values is more abrupt.

As stated on page 25 of the previous office action, it would have been an obvious engineering design choice to make the function a *decreasing* function, rather than an increasing function. This engineering design choice is based merely on how one defines the variable α. In Fan, α increases from 0 to 1, with 0 signifying that there will be no edge enhancement, and 1 signifying great edge enhancement. If one were to simply reverse this setup, and have 0 signify great edge enhancement and 1 signify no edge enhancement, then the function of α will be a decreasing function. The only alteration that would then need to be made would be to the update equations for $y(m,n)$. The update equations would be:

$$y(m,n) = (1-\alpha)x^*(m-T_x,n) + \alpha x^*(m,n) \text{ when } |dif0| \le |dif1| \text{ and}$$

$$y(m,n) = (1-\alpha)x^*(m+T_x,n) + \alpha x^*(m,n) \text{ otherwise.}$$

Thus, the obvious engineering design choice is really a matter of how the equations defining the system and method are *expressed*, rather than a difference relating to the substance of operation. The output pixel values based on the obvious engineering design choice will be the same. It is merely how the equations are expressed in the computations that is different since the value of α without applying the obvious engineering design choice will be the same as the value of $(1-\alpha)$ with the application of the obvious engineering design choice.

<u>With respect to page 21, lines 10-12 (Section F) of Appeal Brief:</u>

Since the rejections of the claims which have been maintained by Examiner have been demonstrated to be fully supported, and Appellant's arguments have been fully addressed and overcome, Examiner respectfully requests that the Board affirm the Examiner is his rejections.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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